Zanthoxylum martinicense (Lam.) DC. Espino Rubial

SO-ITF-SM-42
March 1991

Rutaceae Rue family

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UNIVERSITY OF MINNESOTA
OCT 3 1997
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Zanthoxylum martinicense (Lam.) DC., known as espino rubial in Puerto Rico (*15*), pino macho in the Dominican Republic (*28*), ayúa in Cuba (*25*), yellow hercules in Jamaica (*27*), and bosú in Venezuela (*29*), is a medium-sized tree of moist secondary forests. Common in most of its West Indies range, the species has long, clear boles (fig. 1) with large scattered conical spines. Trees have sparse crowns with light-green, pinnately compound leaves. Espino rubial wood is of medium density and light colored. Although the wood has a number of uses, it is not widely known or used because it is not abundant and lacks exceptional qualities.

HABITAT

Native Range

Espino rubial grows in forests of the Greater and Lesser Antilles (*12*), Trinidad and Tobago (*18*), eastern Venezuela (*29*), and probably Guyana (fig. 2). Its native range extends from 5° to 23° N. latitude and from about 60° E. to 85° E. longitude. The species is not known to have naturalized outside its native range.

Climate

Espino rubial is mostly confined to moist forests where the mean annual precipitation is between 1000 to 2000 mm and wet forests where mean annual precipitation reaches about 3000 mm. It may also be found in moist microsites (such as stream bottoms) in the dry forest (less than 1000 mm mean annual precipitation). Rainfall may be evenly distributed as in some upland habitats in the Antilles or there may be a pronounced dry season of 3 to 5 months, as in Venezuela (*29*). Mean January and July temperatures in the Greater and Lesser Antilles average around 23 and 27 °C, respectively (*26*). In the northern South America, mean monthly temperatures vary little from month to month, ranging from 22 to 26 °C, depending on elevation (*10*).

Soils and Topography

Espino rubial most commonly grows on clay soils (*18*), both those derived from limestone, which tend to be shallow and cherty (*9*), and those from igneous rocks. The species also grows on alluvial soils in river bottoms (*19, 23*) and on coastal sands (*8*). Although the species colonizes several soil orders, the two most frequently supporting espino rubial are Ultisols and Inceptisols. The soil types colonized in Puerto Rico would indicate that the species tolerates a pH range between about 5.0 and 8.0. Although espino rubial is adapted to the anaerobic subsoils common to clays in moist habitats, it does not grow on poorly drained soils (saturated to the surface much of the year) (author, personal observation). The species can be found growing from near sea level to about a 600-m elevation in Puerto Rico, up to a 900-m elevation in Cuba (*25*), and on slopes varying from level to steep. Presently, much of the espino rubial trees can be found growing on abandoned farm lands, which are often eroded and low in available nutrients.

Figure 1.—*Espino rubial* (Zanthoxylum martinicense) *tree growing in Puerto Rico.*

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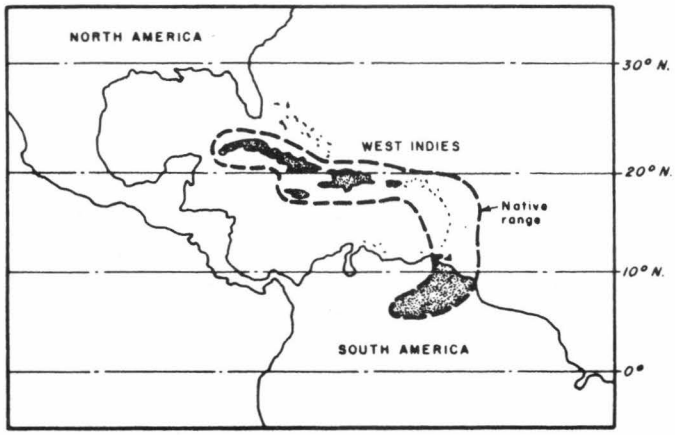

Figure 2.—*Native range of espino rubial* (Zantoxylum martinicense) *in the West Indies and South America.*

Associated Forest Cover

In the Trinidad Mountains of Cuba, espino rubial is found growing with *Andira inermis* (W. Wright) H.B.K., *Cedrela odorata* L., *Guarea guidonia* (L.) Sleumer, *Hibiscus* sp., *Magnolia cubensis* Urb., *Prunus occidentalis* Sw., and *Swietenia mahagoni* Jacq. (*25*). A coastal moist evergreen forest in Puerto Rico containing espino rubial was dominated by *Bucida buceras* L., *Calophyllum brasiliense* Jacq., *Mammea americana* L., *Mastichodendron foetidissimum* (Jacq.) H.J. Lam, and *Manilkara bidentata* (A. DC.) A. Chev. (*8*). In a mesic forest between limestones hills in Puerto Rico, espino rubial was codominant with *Phoebe elongata* (Vahl) Nees, Spondias mombin L., *Inga laurina* (Sw.) Willd., and *G. guidonia* (*4*). In Trinidad and Tobago, espino rubial grows in the *Carapa guianensis* Aubl.—*Lecythis laevifolia* Griseb.—*Sabal mauritiiformis* Gr. & Wendl. forest type and in the *Trichilia oblanciolata* Rusby—*Brosimum alicastrum* Sw. forest type, although it is not common in either (*18*).

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Espino rubial produces dense flower clusters (panicles) 5 to 15 cm long and about the same width that are usually in a terminal position on branches (*15*, *18*). The individual greenish-white flowers are small, 3 to 4 mm across (*13*). The species is dioecious, male and female flowers being borne on different trees. Espino rubial has been reported to flower and bear fruit almost throughout the year in the Dominican Republic (*13*), to flower from April through May and bear fruit from August through November in Cuba (*9*), and to flower and bear fruit from spring to fall in Puerto Rico (*15*). The seeds are reported to mature in September in Trinidad and Tobago (*18*). A group of trees in a moist forest in Puerto Rico flowered in April, and seeds were collected from them in August. Apparently, 4 months are required for seeds to grow and mature. When dry, each leathery, brown fruit splits along five follicles to release a single shiny, round black seed about 3 mm in diameter (*15*).

Seed Production and Dissemination.—A sample of air-dried seeds collected in Puerto Rico averaged 0.0133 ± 0.0002 g per seed or about 75,000 seeds per kilogram (author, personal observation). Seeds are most easily collected by clipping panicles that have turned brown from the tree. After a few days of air-drying, the fruits open and release their seeds. The seeds are reportedly dispersed by birds and bats (*18*) and are regularly transported to new sites.

Seedling Development.—Germination is epigeous, beginning about 40 days after sowing unscarified seeds. Only 5 percent germinated in a seedlot from Puerto Rico (author, personal observation). It is not known whether low viability was at fault or whether scarification was needed. In another Puerto Rican trial, 5 percent germination was also obtained for *Z. flavum* Vahl (*17*). The latter poor results were blamed on weevils.

The newly emerged seedlings are tiny (<1 cm tall) and delicate. They grow slowly at first, but more rapidly after about 3 months. Very limited experience indicates that seedlings grown in nursery bags will be ready to plant (fig. 3) about 7 months after seed germination, when they are 0.3 to 0.5 m tall (author, personal observation).

In forests of Puerto Rico, espino rubial seedlings are never numerous, whether under seed-bearing trees or in clearings. However, the seedlings are hardy and aggressive, and only a few are necessary to perpetuate the species in an area. There are no reports of attempts to naturally or artificially regenerate the species. Silvicultural treatments, such as group selection, small clearcuts, and light shelterwood cuttings with attendant disturbance to the forest floor that mimic sit-

Figure 3.—*Espino rubial* (Zanthoxylum martinicense) *seedling ready for planting.*

uations where espino rubial regenerates naturally are suggested for regenerating espino rubial. After seedlings appear, they could benefit by weedings and cleanings, although this may not always be necessary. If the establishment of plantations becomes an objective, using containerized stock certainly would be the safest approach. Bare-root or stumped (tops removed) plants may also merit testing. Initial spacings of 3 m have worked well for a number of other similar species.

Vegetative Reproduction.—Saplings and small poles sprout readily (author, personal observation); however, it is not known whether large trees will sprout. Coppicing does not appear to be an important means of reproduction. Root sprouts have not been noted in the literature. When a group of woody cuttings from saplings were stuck in moist soil under partial shade, 7 percent rooted in 4 months (author, personal observation). The growth of rooted cuttings is rapid.

Sapling and Pole Stage to Maturity

Growth and Yield.—Espino rubial has a reputation for fast growth (*18*), although little substantiating data is available. On two moist forest sites with clay soil in Puerto Rico, mean annual diameter increment was 0.15 and 0.20 cm for mostly pole-sized trees in intermediate crown positions (*30*). Dominant and codominant trees on better soils can be expected to grow considerably faster. Espino rubial reaches at least 25 m in height and 0.8 m in d.b.h. (diameter at breast height) in Puerto Rico (author, personal observation). Maximum heights of 20 m are reported as the norm for most sites (*3*, *13*, *15*), and boles are usually straight and clear, 4.5 to 6.0 m from the base to the start of heavy branching (*9*). This species could be easily grown to a 0.5-m d.b.h. in Puerto Rico. Judging by the general age of the forests where these trees grow and the sizes of dominant espino rubial, this commercial diameter could be reached in 60 to 75 years under good management. There appears to be little present economic incentive to plant it or to manage for high concentrations of the species in stands, but where good trees are present in natural stands, at least some of them should be managed for their timber and to maintain biological diversity.

Espino rubial was the 43rd most important tree (in terms of total basal area of 173 species sampled) in an inventory of Puerto Rican secondary forests in 1980 (*2*). More than 9000 m^2 of basal area (0.6 percent of the total) was estimated for espino rubial on Puerto Rico, most of it in small diameter classes. The mean crown ratio (crown diameter/d.b.h.) for 27 espino rubial trees in two forests in Puerto Rico was 36.5 ± 1.1 (author, personal observation). This ratio is high for tropical hardwoods but not unexpected for a thin-crowned species such as espino rubial.

Rooting Habit.—Lateral roots of espino rubial are stout and covered with short mycorhizal roots (author, personal observation). Buttressing in older trees varies from pronounced to absent.

Reaction to Competition.—Espino rubial is intolerant of shade (*15*, *18*) and cannot survive long in a suppressed canopy position. In competition with faster growing and taller secondary forest species, it usually occupies a codominant or intermediate crown position in the canopy. New seedlings spring up in clearings, large gaps, and plantations of moderate and slow growing species. The seedlings are not numerous, but they exhibit vigorous growth and high survival. Once established, seedlings compete well with grass, weeds, and brush. The species is adapted to secondary forests and is common in abandoned farmland, neglected coffee shade (*2*), and degraded forest. Espino rubial can become a nuisance when it invades new plantations and must be controlled like other weed trees (*18*). Growing in groups or singly, espino rubial generally composes a minor portion of stands where it occurs. Six subtropical moist (classified according to Holdridge, *11*) forest stands in Puerto Rico containing espino rubial averaged 1.2 m^2/ha (with a range of 0.2 to 2.8 m^2/ha) in stands averaging 17.0 m^2/ha in total basal area (*4*, *30*, *31*).

Damaging Agents.—No serious plagues and little insect activity has been noted on living espino rubial trees. One Lepidopteran species, *Papilio pelaus imerius* Godard, was noted consuming espino rubial foliage (*18*). Wet-wood termites, *Nasutitermes costalis* (Holmgren), commonly consume dead limbs and occasionally invade exposed bolewood of espino rubial. Sawn wood in contact with the ground in the Dominican Republic is reported to be extremely susceptible to termites (*24*). The wood is also susceptible to attack by dry-wood termites, *Cryptotermes brevis* (Walker) and several genera of pinhole borers (*15*, *16*). Eighty-five percent of small untreated posts set in the ground in Puerto Rican durability tests were rendered unserviceable by decay and termites within 1 year (*6*). The average service life for untreated espino rubial posts was estimated to be 0.9 years and for treated posts (cold-soaked for 5 days in diesel with 5-percent pentachlorophenol) the average was 2.7 years (*5*). The sapwood of espino rubial is poorly penetrated by preservative (cold-soaked with pentachlorophenol in diesel) (*7*). Also, the wood of espino rubial is not durable in exposed, aboveground positions (*27*), but neither is it susceptible to sap stain (*16*).

In an islandwide inventory of forests in Puerto Rico, of 987 espino rubial trees tallied, 92 percent of the saplings, 10 percent of the poles, and 34 percent of the sawtimber trees were sound and free of disease and defect (*1*). For poles and saplings, form was the most common defect, while the usual source of defect in sawtimber was disease—probably heart and butt rots. Twenty-four percent of the sawtimber volume was regarded as cull.

Espino rubial is moderately resistant to wind damage. It tends to defoliate and lose small branches rather than suffer breakage of major branches, trunk snap, or wind throw (author, personal observation).

SPECIAL USES

The heartwood of espino rubial is cream to light brown in color, occasionally with a greenish-blue cast (*16*). The sapwood is a little lighter colored but not easily distinguishable from the heartwood. Growth rings are distinct, and the grain pattern and appearance are reminiscent of ash (*Fraxinus* spp.). The wood is moderately heavy and hard, has a straight to irregular grain, and displays good luster. The density appears somewhat variable. A density of 0.66 g/cm^3 (moisture content not given) is reported for Cuba (*9*); another of 0.58 g/cm^3 (moisture content not given) for Trinidad and

Tobago (*18*); and densities of 0.56 g/cm^3 (air-dry) (*16*), 0.46 g/cm^3 (moisture content not given) (*15*), and 0.43 g/cm^3 (ovendry) (author, personal observation) were measured in Puerto Rico.

The wood of espino rubial seasons rapidly, although considerable value is lost through bow, twist, crook, and checking of the lumber (*16*). During the seasoning process, the wood shrinks 1.5 percent radially and 2.6 percent tangentially. Even though the wood works easily with hand or power tools, torn and fuzzy grain are common occurrences. Espino rubial wood has good resistance to splitting by screws, and a beautiful finish can be achieved (*20*). A pH of 5.3 was measured for the sapwood, a value that presents little risk for corrosion of fasteners (*22*).

Espino rubial was once an important wood for construction in rural areas (*24*), but this role is now mostly filled by treated pine. The wood is sometimes used for boxes, pallets, inexpensive furniture, cabinetry, and horticultural stakes (*13*, *16*, *27*). Espino rubial wood is probably suitable for veneer and corestock (*16*) and as a source of flakes and chips for making medium-density composite boards. The wood is undoubtedly used for fuel and for making charcoal in rural areas.

Extractions of the bark and leaves of this tree are used in herbal medicine to treat numerous ailments, ranging from toothache to venereal ulcers (*21*, *28*). Espino rubial has been grown for shade in Cuba and Florida (*15*). One objection to the use of espino rubial as a shade tree is the presence of spines on the trunk; however, they are not numerous and are easily broken off. The main drawback to its use for domestic shade is that it has a sparse crown and it is not readily propagated. Espino rubial flowers are a source of nectar for bees (*15*).

GENETICS

Botanical synonyms are *Fagara martinicense* Lam., *Z. juglandifolium* Willd., *Z. album* Vahl, and *Z. clava-herculis* Griseb. (*12*). The genus *Zanthoxylum* contains 250 to 300 species, mostly from tropical and subtropical areas (*12*, *14*).

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